PM0XX – 12 MARCH 2024
La Defense – Training with Full Data

Application to Urban Wind Field Dispersion Studies

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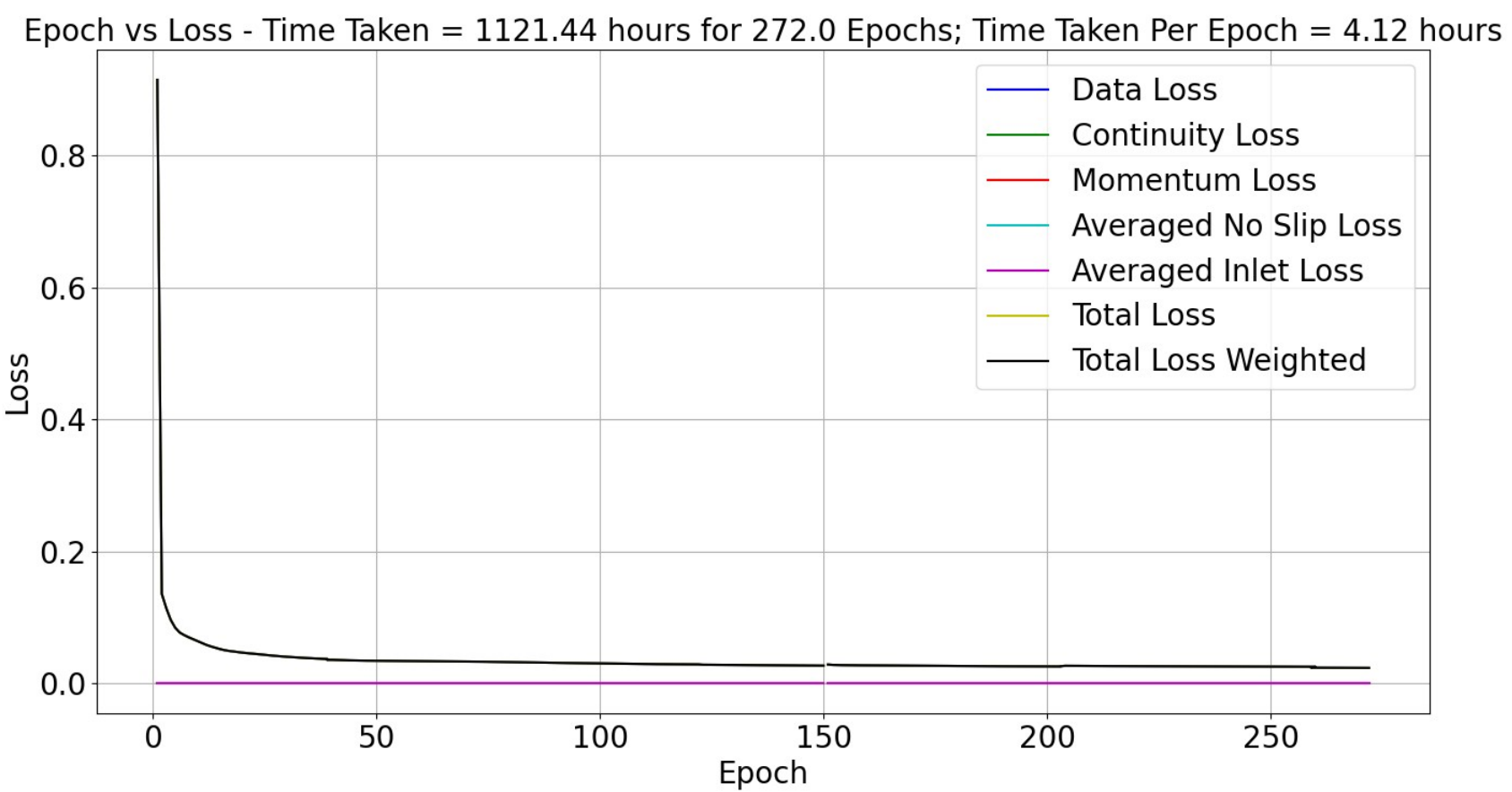
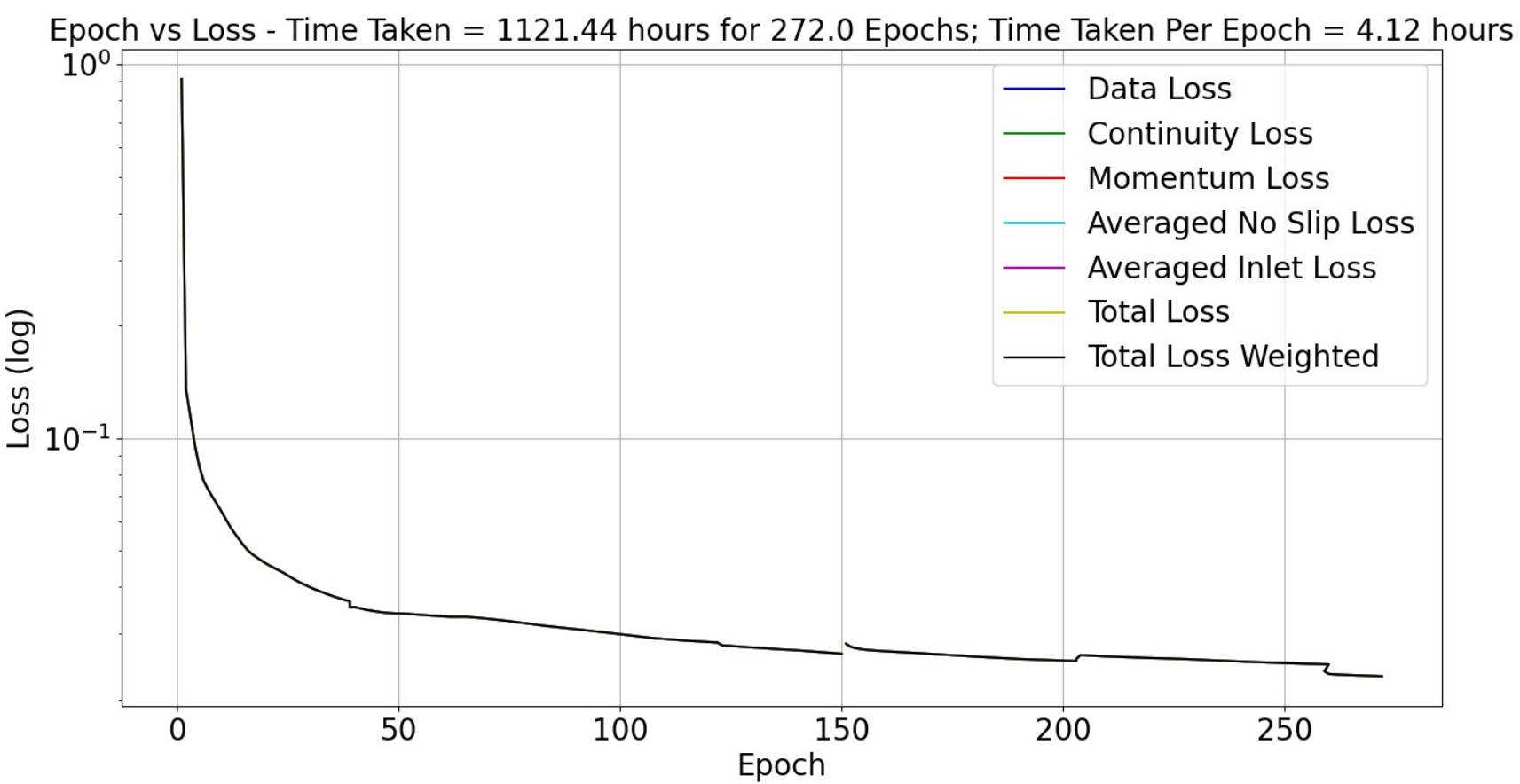
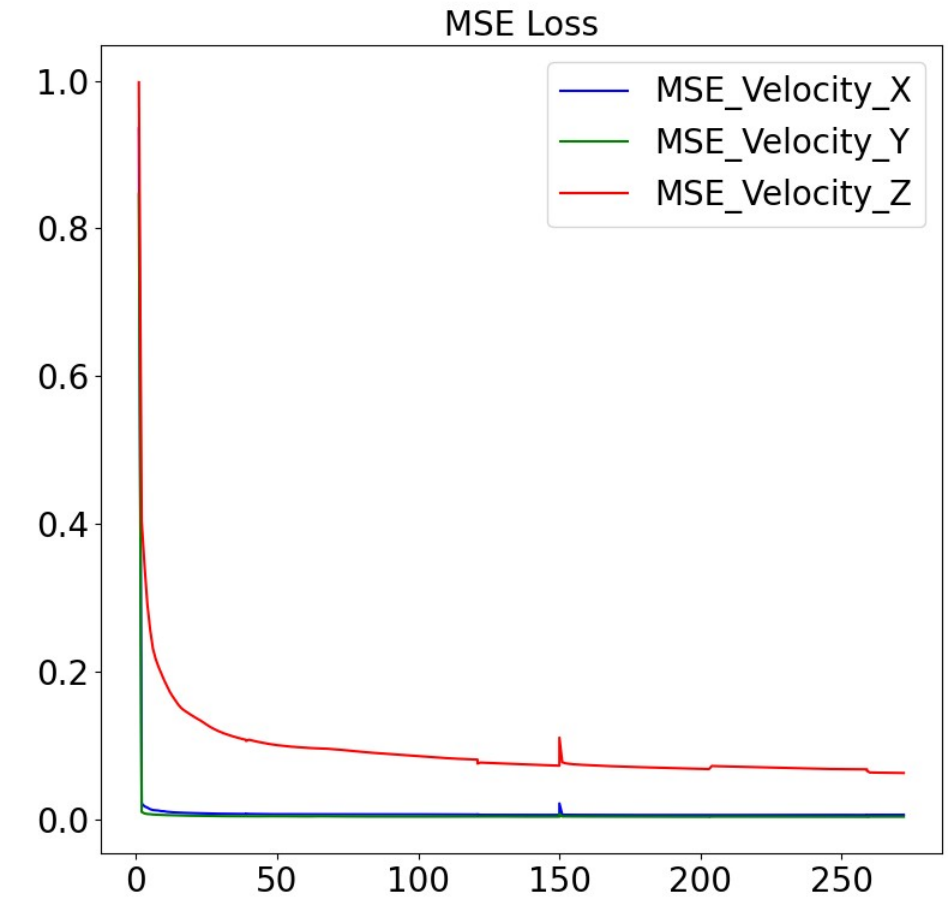
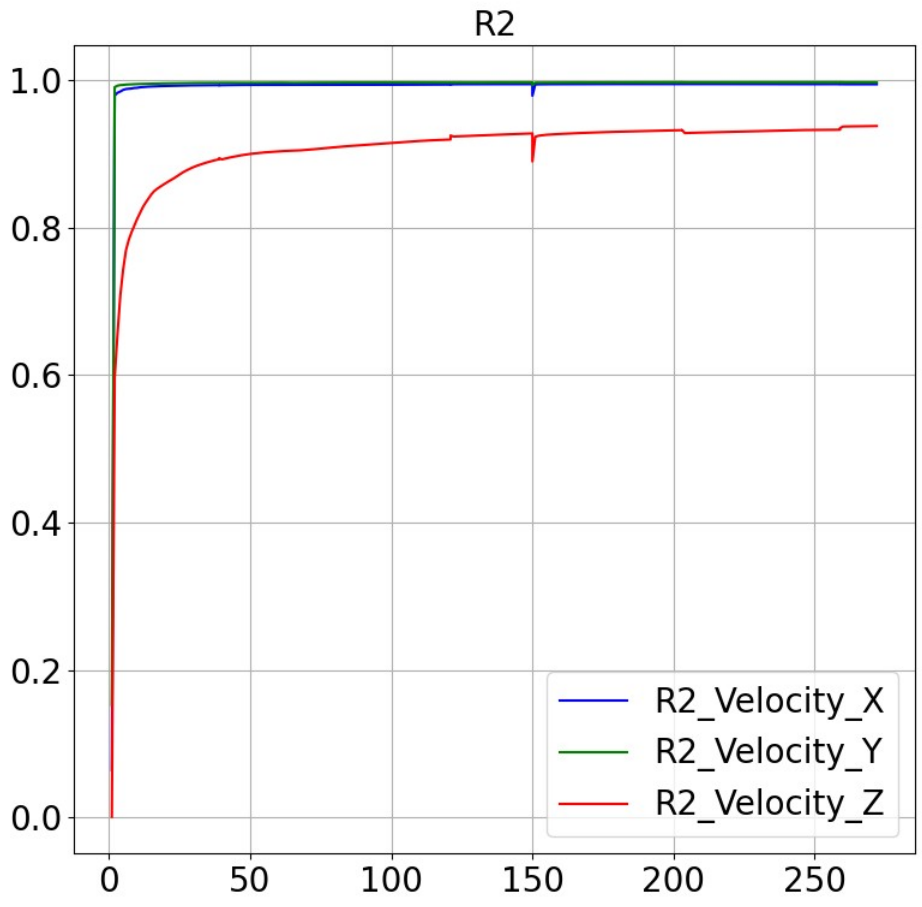
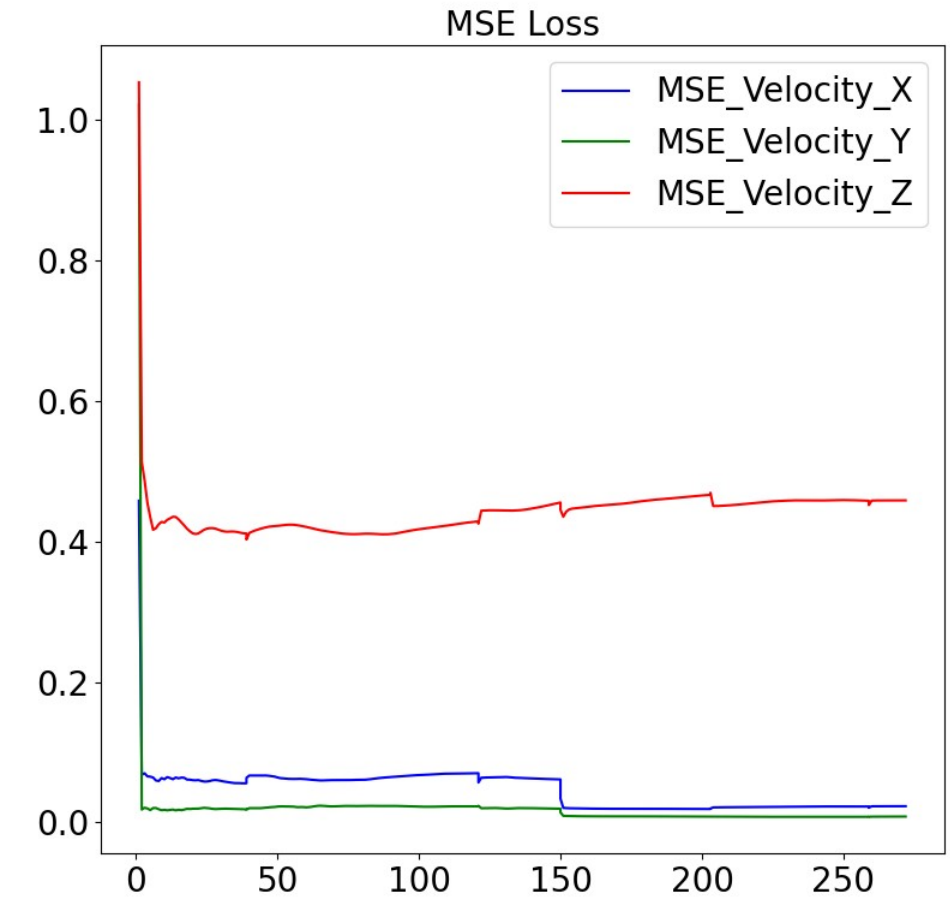
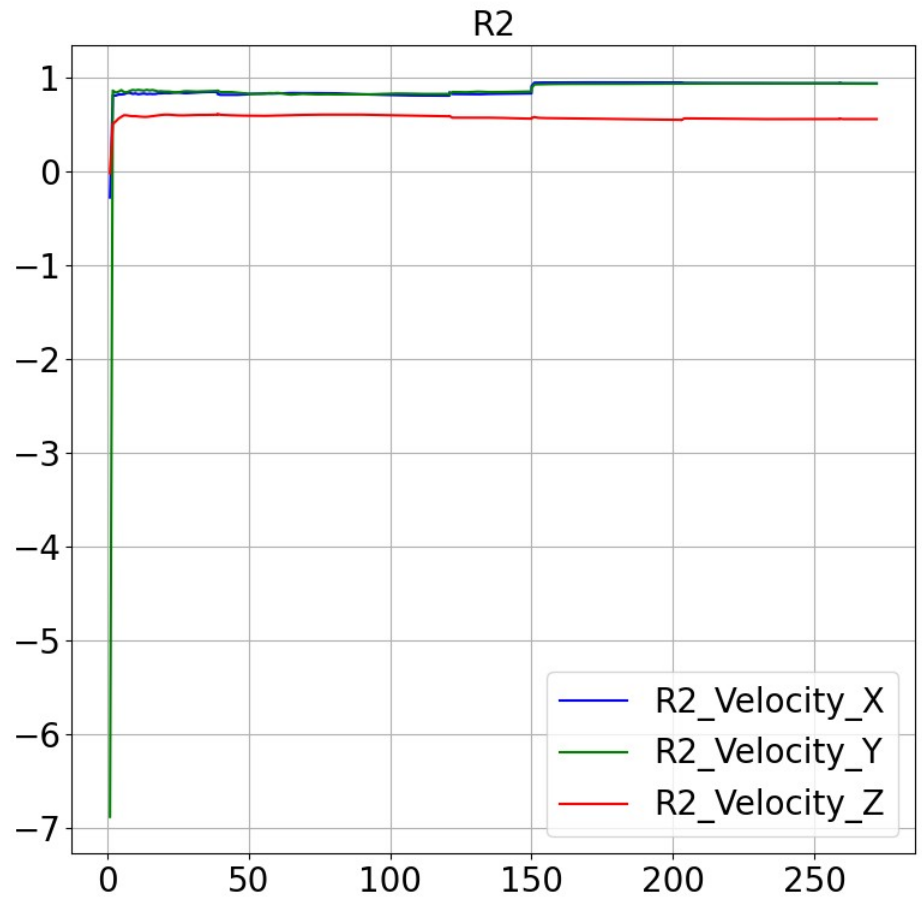

Epoch vs Loss - Time Taken = 1121.44 hours for 272.0 Epochs; Time Taken Per Epoch = 4.12 hours
Data Loss
Continuity Loss
Momentum Loss
Averaged No Slip Loss
Averaged Inlet Loss
Total Loss
Total Loss Weighted
Loss
0.0
0.2
0.4
0.6
0.8
0
50
100
150
200
250
Epoch


Epoch vs Loss - Time Taken = 1121.44 hours for 272.0 Epochs; Time Taken Per Epoch = 4.12 hours
10^0
10^{-1}
Loss (log)
0
50
100
150
200
250
Epoch
Data Loss
Continuity Loss
Momentum Loss
Averaged No Slip Loss
Averaged Inlet Loss
Total Loss
Total Loss Weighted


MSE Loss
MSE_Velocity_X
MSE_Velocity_Y
MSE_Velocity_Z
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250


R2
R2_Velocity_X
R2_Velocity_Y
R2_Velocity_Z
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250


MSE Loss
MSE_Velocity_X
MSE_Velocity_Y
MSE_Velocity_Z
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250


R2
1
0
−1
−2
−3
−4
−5
−6
−7
R2_Velocity_X
R2_Velocity_Y
R2_Velocity_Z
0
50
100
150
200
250

Progress so far - Data Loss Only
Standard Normal Scalar – ELU Activation
(Adam Optimizer)

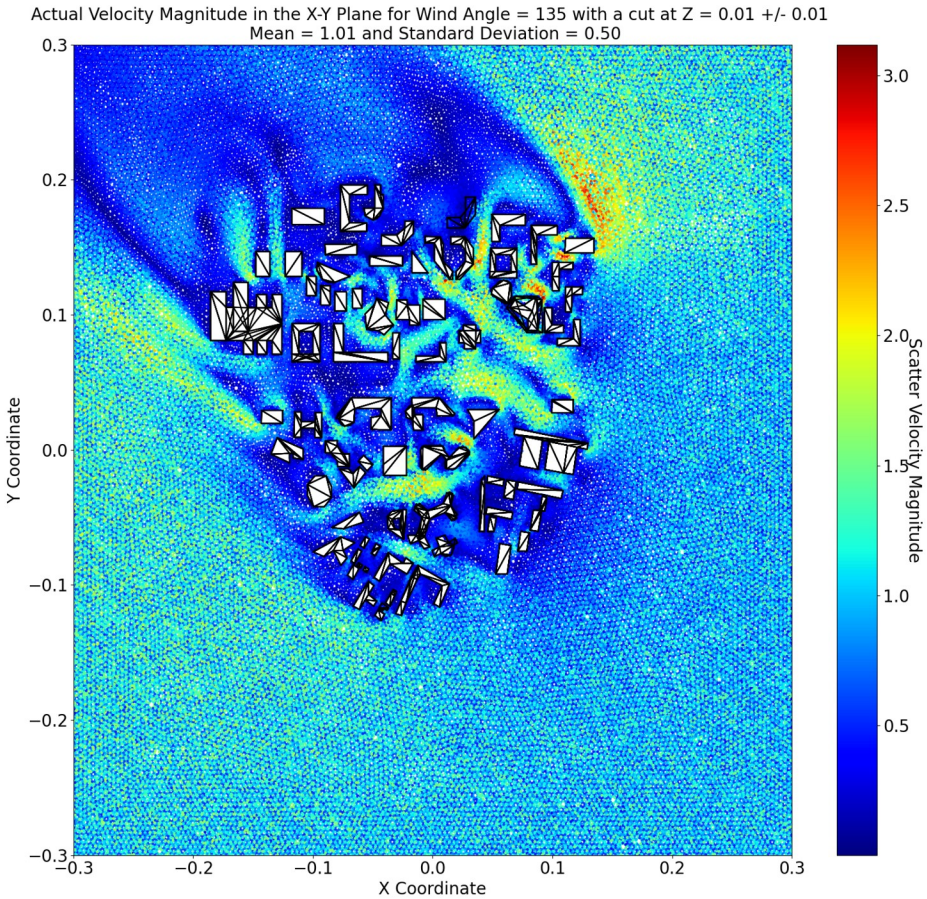
Threshold = SMA 1E-5 (272 Epochs, not completed), GPU Workstation

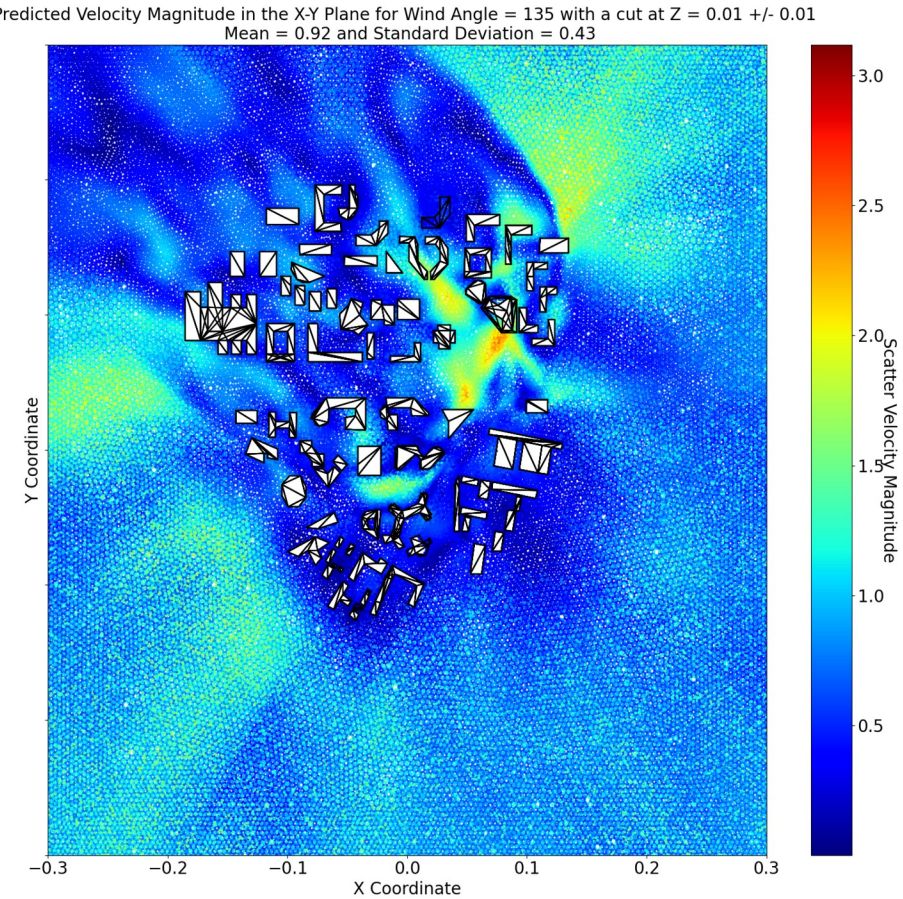
Scripts v5 – PREDICTING (Angle = 135)

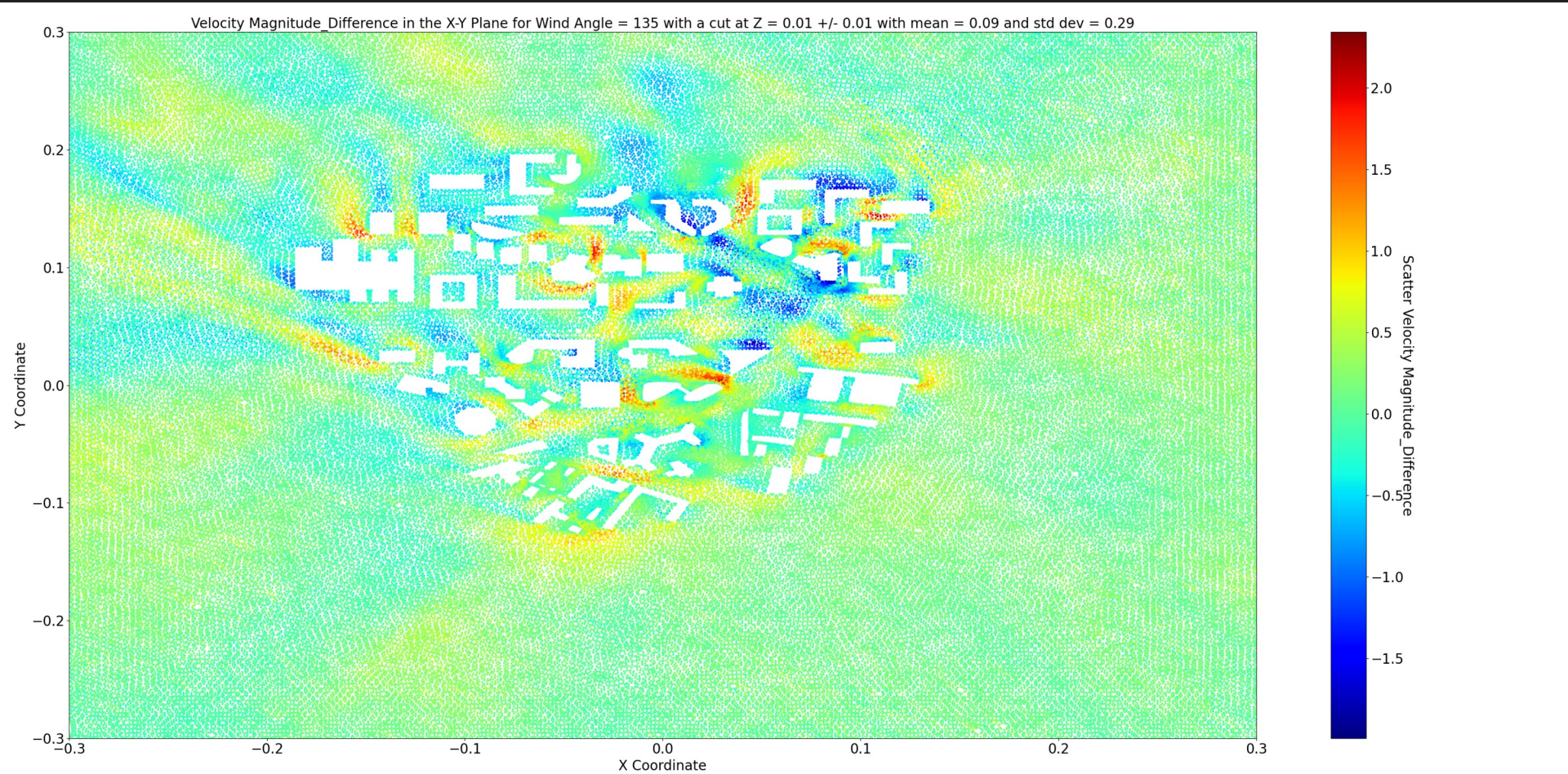
Progress so far - Data Loss Only, Standard Normal Scalar, ELU Activation, Adam Optimizer
Threshold = SMA 1E-5 (272 Epochs, not completed), GPU Workstation
Predicting Results – Metrics (Angle = 135)

Variable	MSE	RMSE	MAE	R2
Velocity_X	0.068945975162	0.262575656073	0.180285294809	0.936113840216
Velocity_Y	0.077839249891	0.278996863587	0.185236902932	0.931721579583
Velocity_Z	0.008489086131	0.092136236800	0.035647019577	0.554629052607

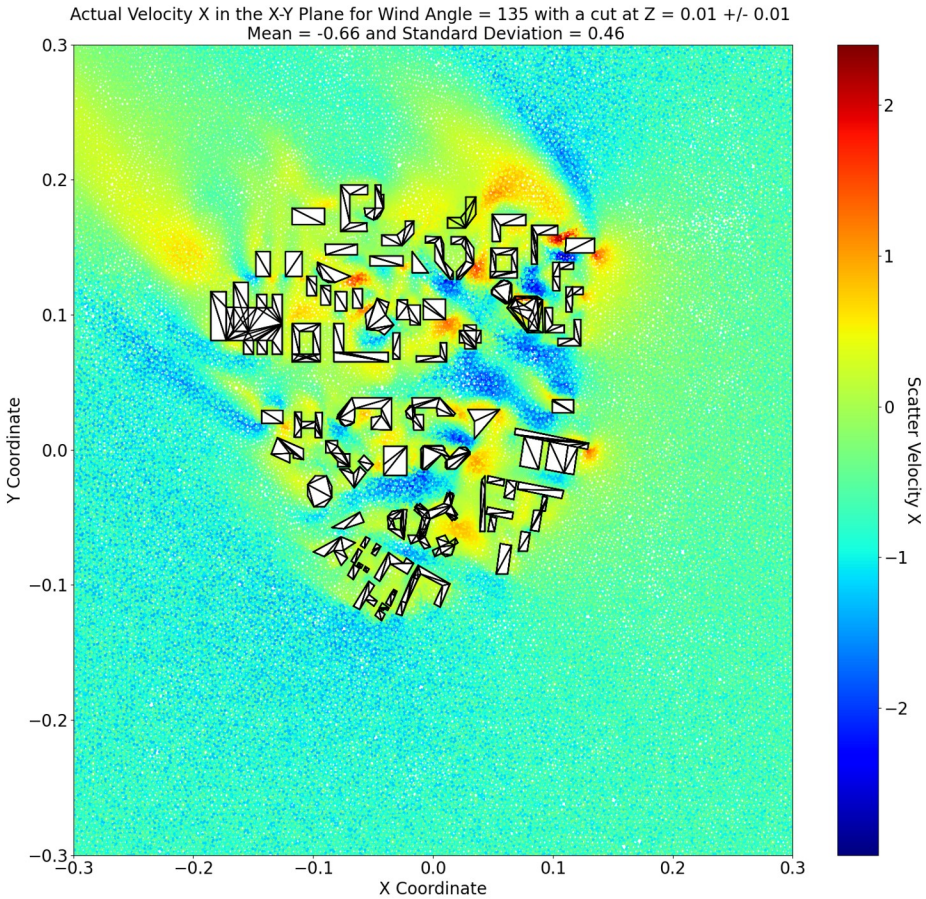
Comparison of Actual vs. Predicted values with Wind Angle = 135 in the X-Y Plane with a cut at Z = 0.01 +/- 0.01

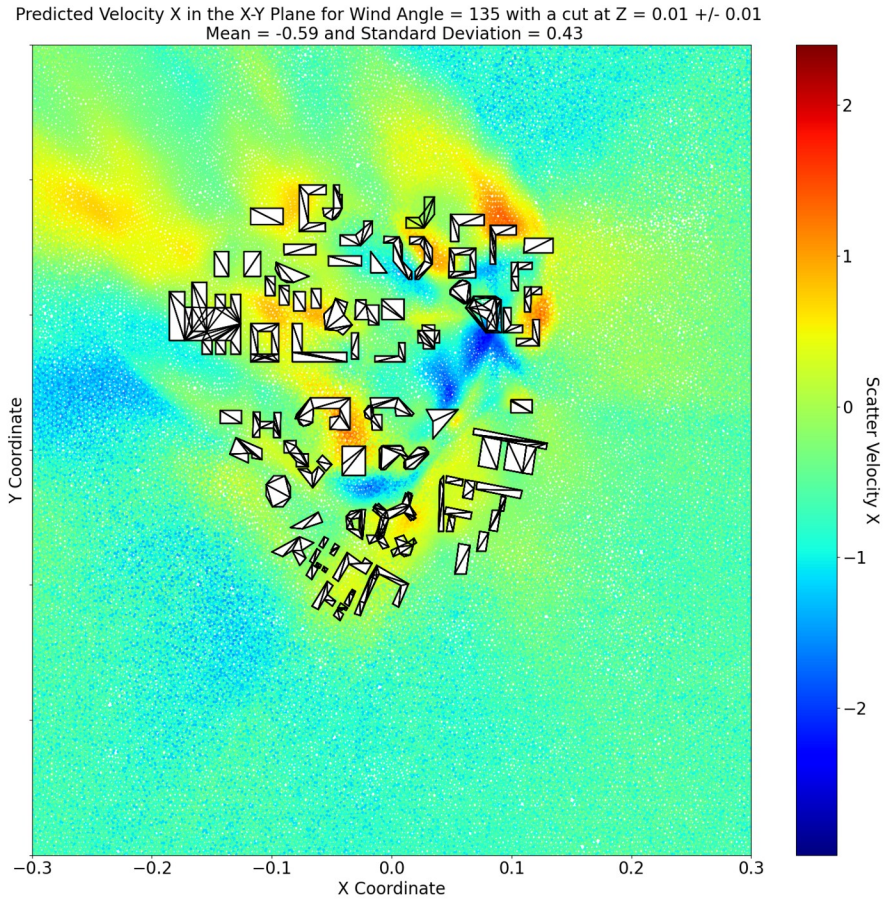


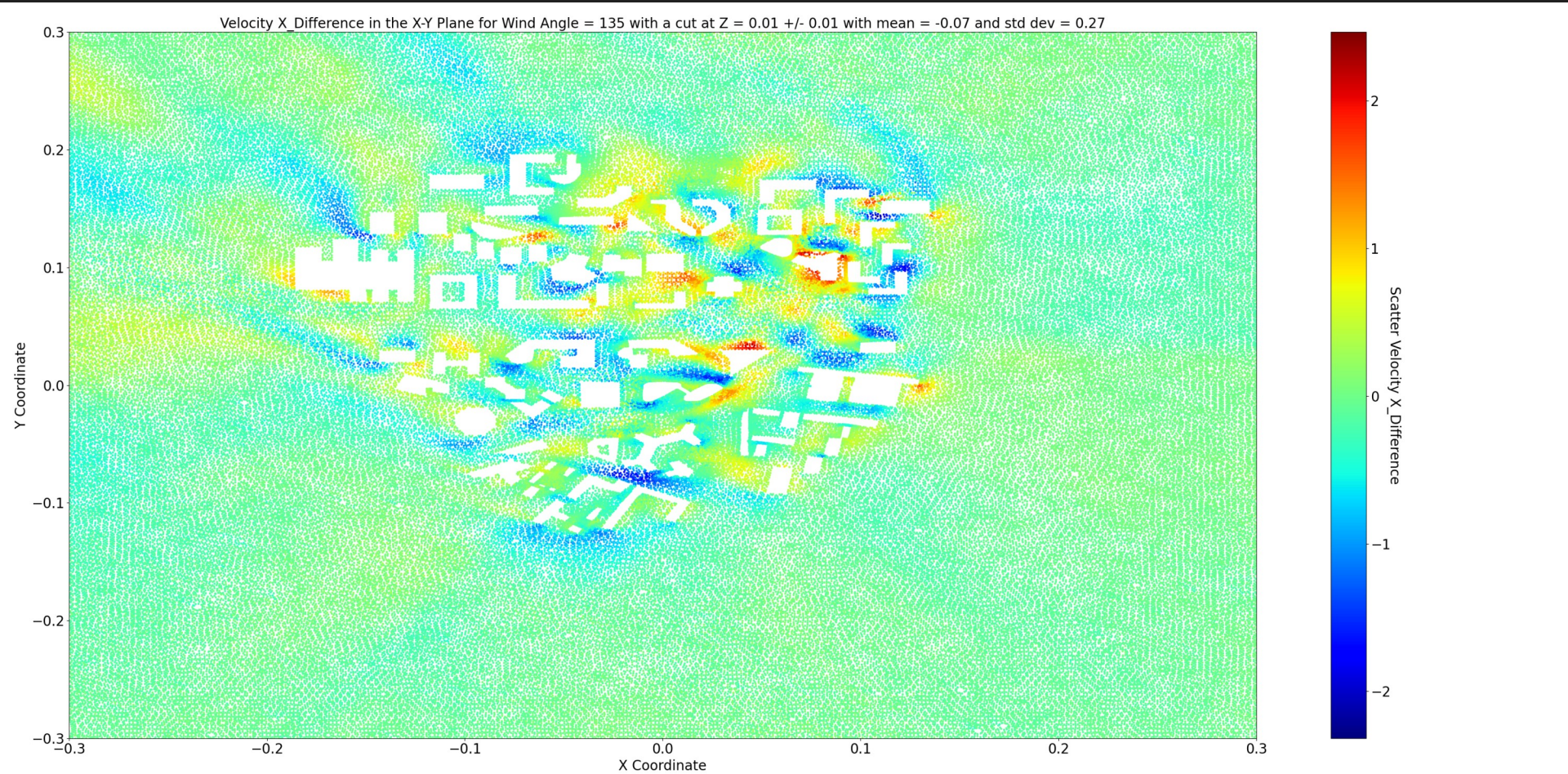



Velocity Magnitude_Difference in the X-Y Plane for Wind Angle = 135 with a cut at Z = 0.01 +/- 0.01 with mean = 0.09 and std dev = 0.29
Y Coordinate
X Coordinate
Scatter Velocity Magnitude_Difference
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5

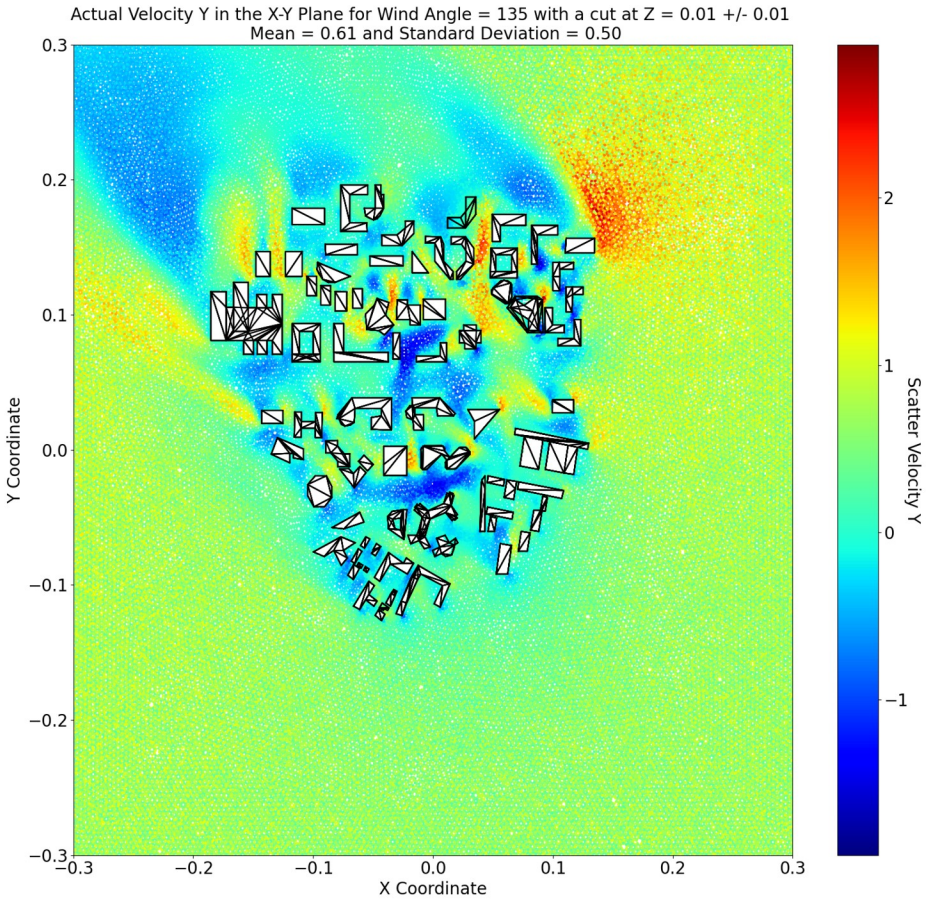
Comparison of Actual vs. Predicted values with Wind Angle = 135 in the X-Y Plane with a cut at Z = 0.01 +/- 0.01

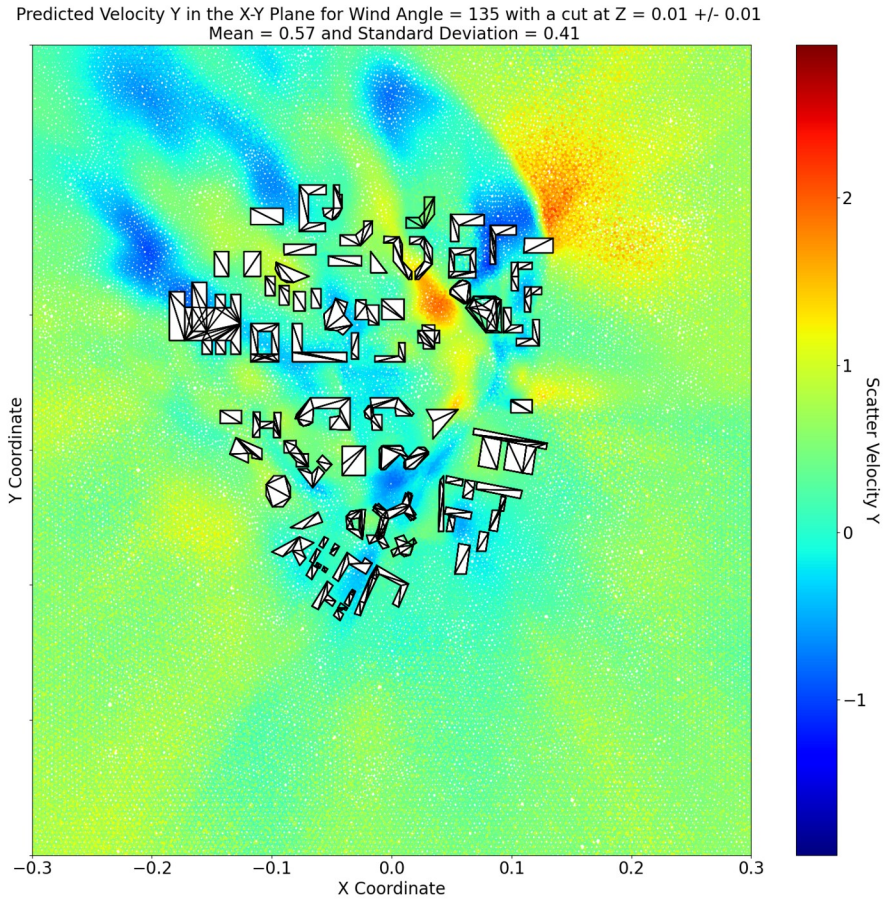


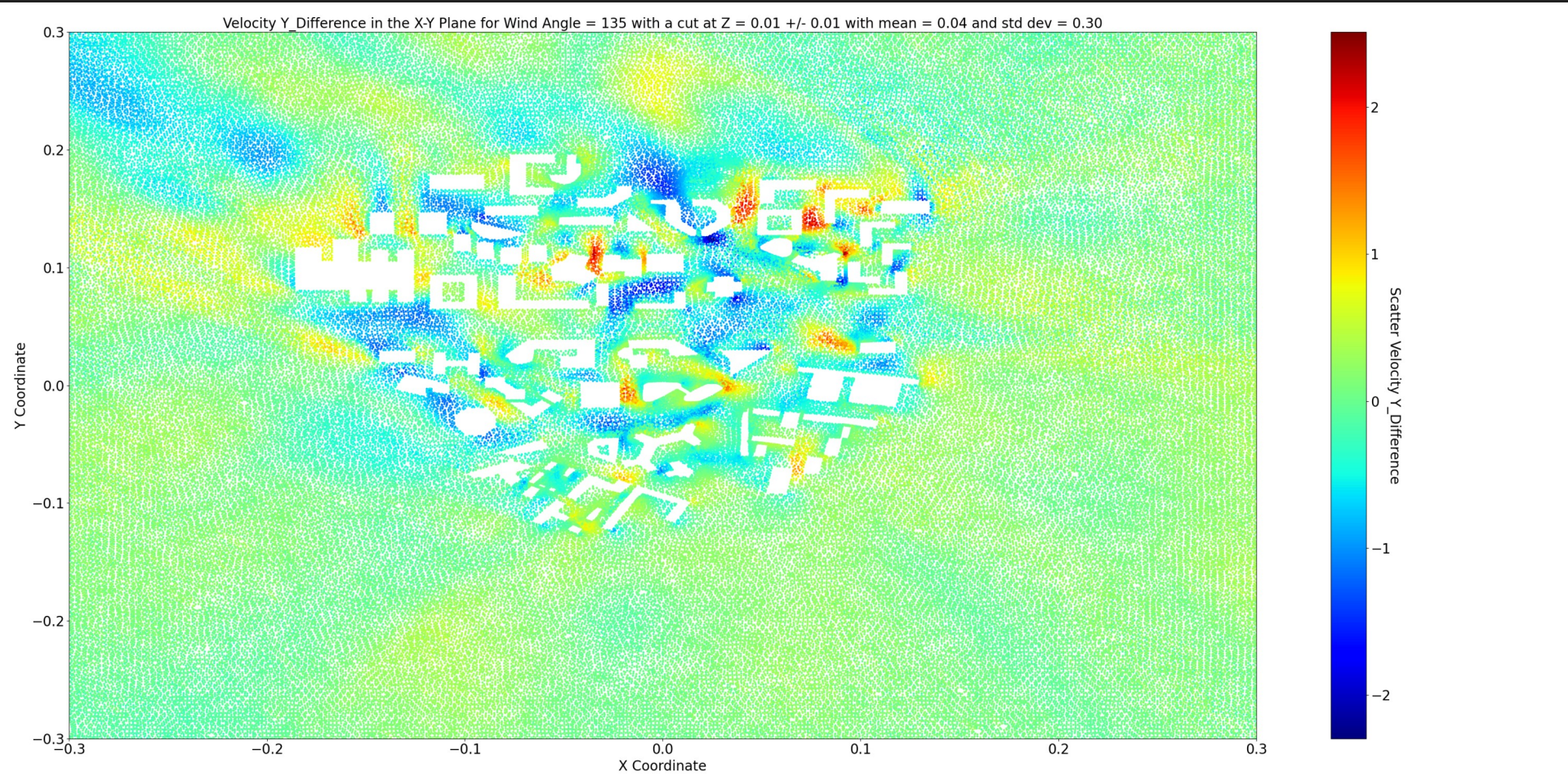



Velocity X_Difference in the X-Y Plane for Wind Angle = 135 with a cut at Z = 0.01 +/- 0.01 with mean = -0.07 and std dev = 0.27
Y Coordinate
X Coordinate
Scatter Velocity X_Difference
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3
2
1
0
−1
−2

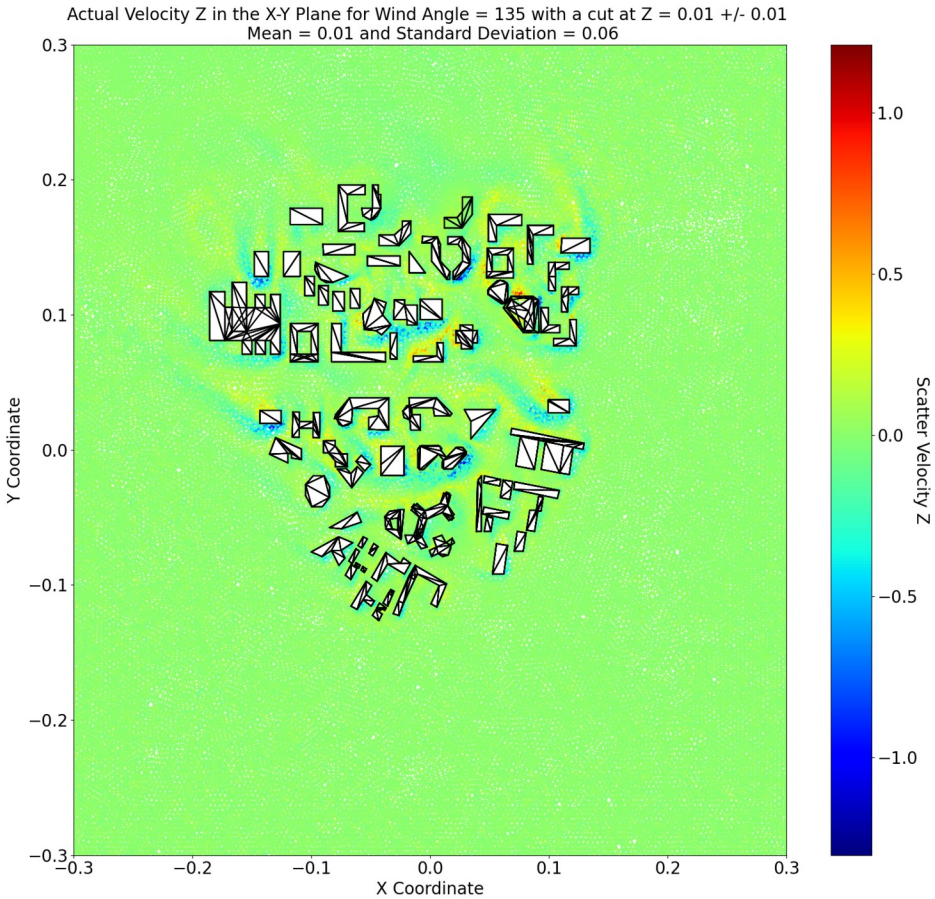
Comparison of Actual vs. Predicted values with Wind Angle = 135 in the X-Y Plane with a cut at Z = 0.01 +/- 0.01

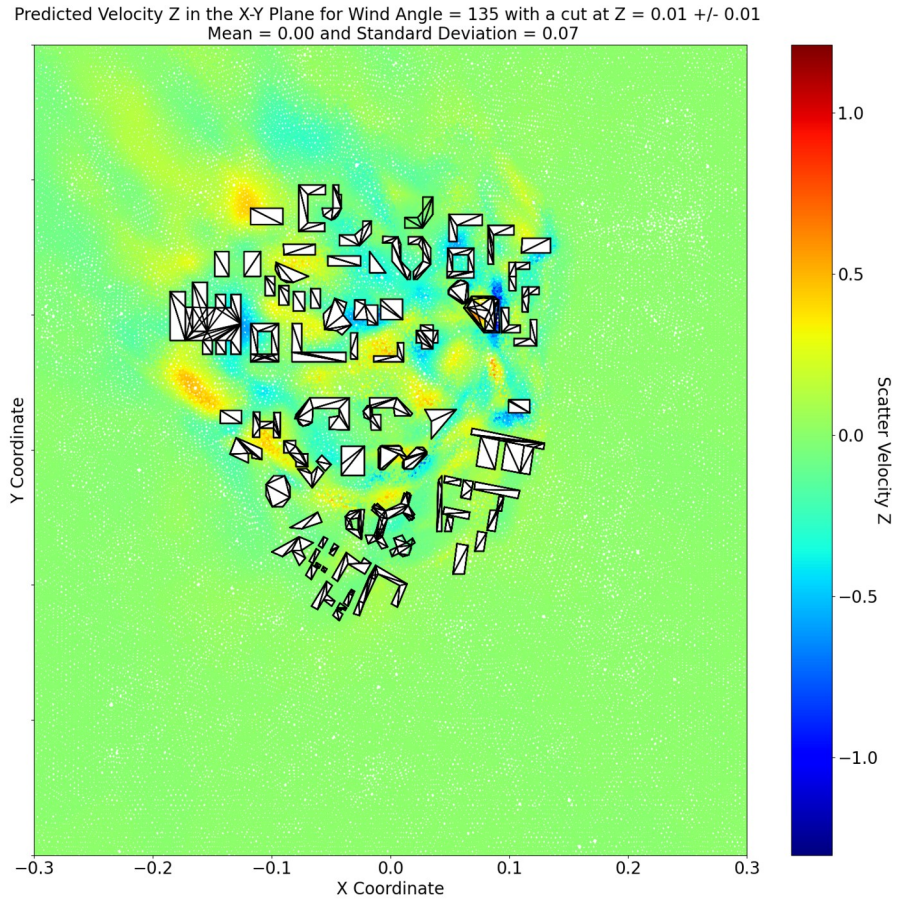


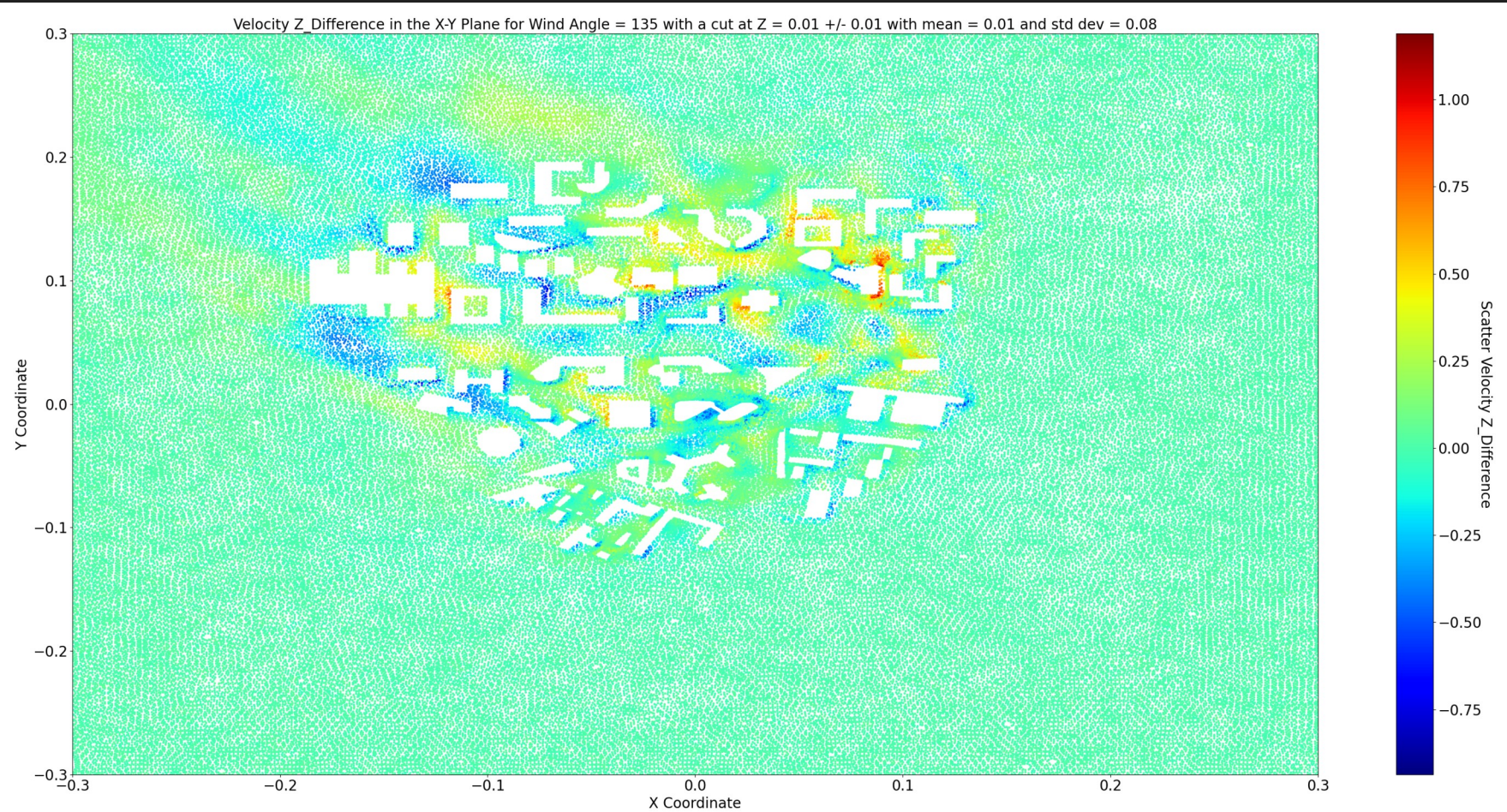



Velocity Y_Difference in the X-Y Plane for Wind Angle = 135 with a cut at Z = 0.01 +/- 0.01 with mean = 0.04 and std dev = 0.30
Y Coordinate
X Coordinate
Scatter Velocity Y_Difference
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3
2
1
0
−1
−2

Comparison of Actual vs. Predicted values with Wind Angle = 135 in the X-Y Plane with a cut at Z = 0.01 +/- 0.01

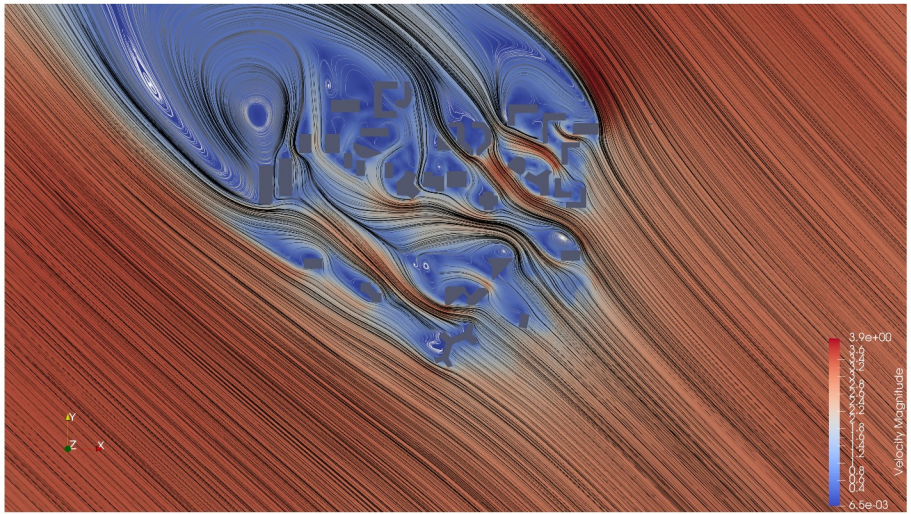




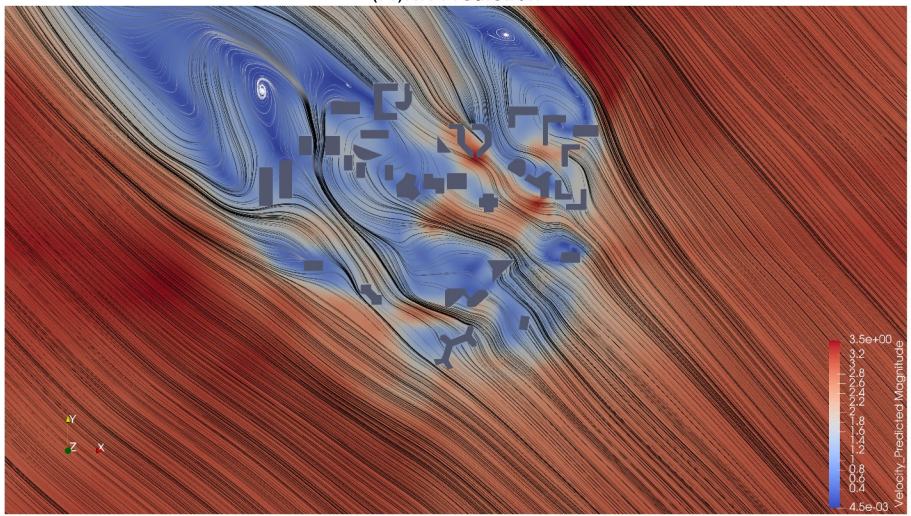

Velocity Z_Difference in the X-Y Plane for Wind Angle = 135 with a cut at Z = 0.01 +/- 0.01 with mean = 0.01 and std dev = 0.08
Y Coordinate
X Coordinate
Scatter Velocity Z_Difference
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75

Actual CFD Data vs (PI)NN Prediction for Wind Angle = 135

Actual CFD Data

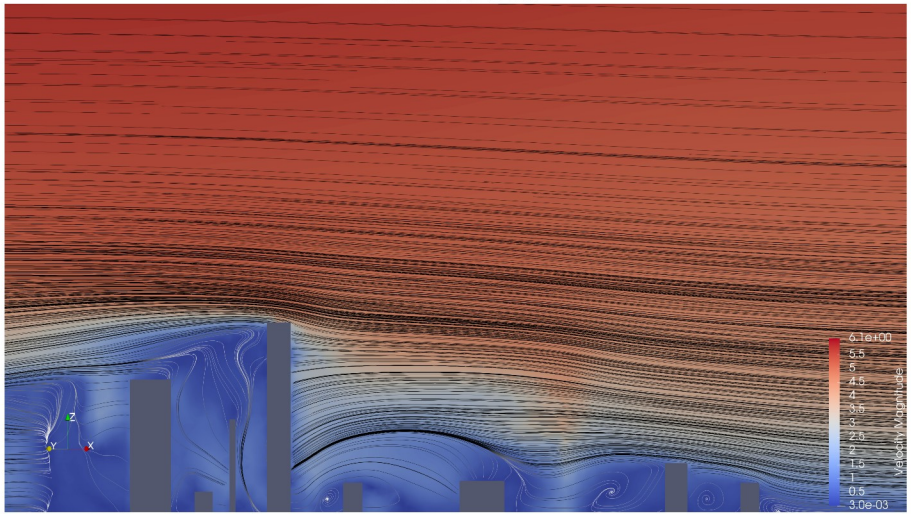


(PI)NN Prediction



Actual CFD Data vs (PI)NN Prediction for Wind Angle = 135

Actual CFD Data



(PI)NN Prediction